

Appln No. 09/966,572
Amdt date December 29, 2003
Reply to Office action of September 25, 2003

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

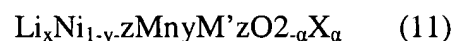
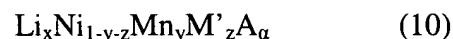
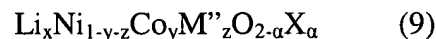
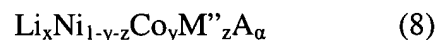
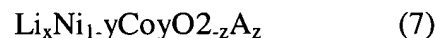
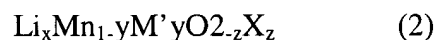
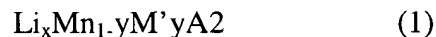
Listing of Claims:

1. (currently amended) A positive active material for a rechargeable lithium battery comprising:

a core comprising a lithiated compound; and

at least ~~one surface treatment layer~~ two metal oxide layers formed on the core, ~~the surface treatment layer comprising at least two coating element included oxides.~~

2. (original) The positive active material according to claim 1, wherein the lithiated compound is at least one compound selected from the group consisting of compounds represented by the formulas 1 to 11:



wherein:

$$0.95 \leq x \leq 1.1, 0 \leq y \leq 0.5, 0 \leq z \leq 0.5, 0 < \alpha \leq 2,$$

M is Ni or Co,

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M' is at least one element selected from the group consisting of Al, Ni, Co, Cr, Fe, Mg, Sr, V, Sc, Y, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Ac, Th, and Pa,

M'' is at least one element selected from the group consisting of Al, Cr, Mn, Fe, Mg, Sr, V, Sc, Y, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Ac, Th, and Pa,

A is selected from the group consisting of O, F, S, and P, and

X is selected from the group consisting of F, S and P.

3. (currently amended) The positive active material for a rechargeable lithium battery according to claim 1, wherein the metal oxide layers each range coating element content of the surface treatment layer ranges from 2×10^{-5} to 1 wt% based on the weight of the positive active material.

4. (currently amended) The positive active material for a rechargeable lithium battery according to claim 3, wherein the metal oxide layers each range coating element content of the surface treatment layer ranges from 0.001 to 1 wt% based on the weight of the positive active material.

5. (canceled)

6. (currently amended) The positive active material for a rechargeable lithium battery according to claim 1, wherein the metal for each metal oxide layer is independently coating element of the surface treatment layer comprises at least one coating element selected from the group consisting of Mg, Al, Co, K, Na, Ca, Si, Ti, Sn, V, Ge, Ga, B, As, and Zr.

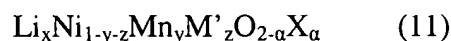
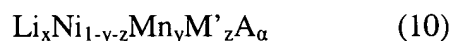
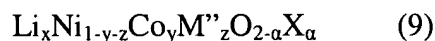
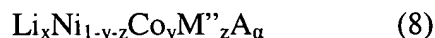
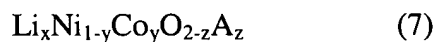
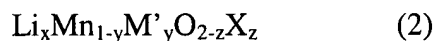
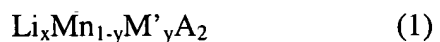
7. (currently amended) A positive active material for a rechargeable lithium battery comprising:

a core comprising at least one lithiated compound; and

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at least two surface-treatment metal oxide layers formed sequentially on the core;
~~at least one of the two surface treatment layers including at least one coating element.~~

8. (original) The positive active material according to claim 7, wherein the lithiated compound is at least one compound selected from the group consisting of compounds represented by the formulas 1 to 11:



wherein:

$$0.95 \leq x \leq 1.1, 0 \leq y \leq 0.5, 0 \leq z \leq 0.5, 0 < \alpha \leq 2,$$

M is Ni or Co,

M' is at least one element selected from the group consisting of Al, Ni, Co, Cr, Fe, Mg, Sr, V, Sc, Y, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Ac, Th, and Pa,

M'' is at least one element selected from the group consisting of Al, Cr, Mn, Fe, Mg, Sr, V, Sc, Y, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Ac, Th, and Pa,

A is selected from the group consisting of O, F, S, and P, and

X is selected from the group consisting of F, S, and P.

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9. (currently amended) The positive active material according to claim 7, wherein the metal oxide layers each range coating element content of the surface treatment layer ranges from 2×10^{-5} to 1 wt% based on the weight of the positive active material.

10. (currently amended) The positive active material according to claim 9, wherein the metal oxide layers each range coating element content of the surface treatment layer ranges from 0.001 to 1 wt% based on the weight of the positive active material.

11. (currently amended) The positive active material according to claim 7, wherein the metal for each metal oxide layer is independently coating element of the surface treatment layer is at least one element selected from the group consisting of Mg, Al, Co, K, Na, Ca, Si, Ti, Sn, V, Ge, Ga, B, As, and Zr.

12. (canceled)

13. (currently amended) A method of preparing a positive active material for a rechargeable lithium battery comprising:

coating a lithiated compound with ~~an~~ a first organic solution or an aqueous solution including at least one coating element source to produce a coated metal oxide-forming compound; and

heat-treating the coated compound to form a first metal oxide coating;

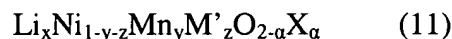
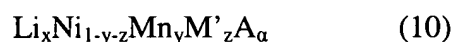
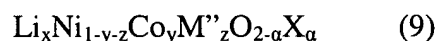
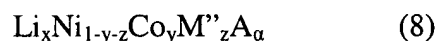
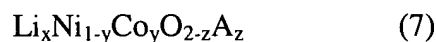
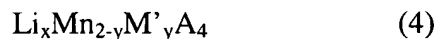
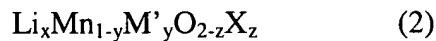
coating the lithiated compound with a second organic solution or an aqueous solution including at least one metal oxide-forming compound; and

heat treating the coated compound to form a second metal oxide coating;

~~wherein the coating and heat-treating steps are performed at least once.~~

14. (original) The method according to claim 13, wherein the lithiated compound is at least one compound selected from the group consisting of compounds represented by the formulas 1 to 11:

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wherein:

$$0.95 \leq x \leq 1.1, 0 \leq y \leq 0.5, 0 \leq z \leq 0.5, 0 < \alpha \leq 2,$$

M is Ni or Co,

M' is at least one element selected from the group consisting of Al, Ni, Co, Cr, Fe, Mg, Sr, V, Sc, Y, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Ac, Th, and Pa,

M'' is at least one element selected from the group consisting of Al, Cr, Mn, Fe, Mg, Sr, V, Sc, Y, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Ac, Th, and Pa,

A is selected from the group consisting of O, F, S, and P, and

X is selected from the group consisting of F, S, and P.

15. (currently amended) The method according to claim 13, wherein the metal oxide layers each comprise content of the coating element source ranges from 0.1 to 50 wt% based on the weight of the positive active material.

16. (currently amended) The method according to claim 15, wherein the metal oxide layers each comprise content of the coating element source ranges from 1 to 20 wt% based on

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the weight of the positive active material.

17. (currently amended) The method according to claim 13, wherein the metal of each of the first and second metal oxides is independently ~~the organic solution or the aqueous solution comprises at least one coating element~~ selected from the group consisting of Mg, Al, Co, K, Na, Ca, Si, Ti, Sn, V, Ge, Ga, B, As, and Zr.

18. (currently amended) The method according to claim 13, wherein each of the organic solution or the solutions or aqueous solution solutions ~~solutions~~ comprises at least two different metal oxides coating elements.

19. (currently amended) The method according to claim 13, wherein at least one of the heat-treatment steps is ~~step is~~ performed at a temperature ranging from 200 to 800°C for 1 to 20 hours.

20. (currently amended) The method according to claim 13, wherein at least one of the heat-treatment steps is ~~step is~~ performed under flowing dry air.

21. (canceled)

22. (original) The method according to claim 13, wherein the coating and the heat-treatment steps are performed three or more times.

23. (currently amended) A positive active material for a rechargeable lithium battery comprising:
a core comprising a lithium-cobalt chalcogenide compound; and
at least two ~~surface-treatment~~ metal oxide layers sequentially formed on the core,
wherein one of the two ~~the surface-treatment~~ metal oxide layers comprises Al₂O₃.

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24. (currently amended) The positive active material of claim 23, wherein the content of Al of the metal oxide ~~surface treatment~~ layer ranges from 2×10^{-5} to 2 percent by weight based on the weight of the positive active material.

25. (currently amended) The positive active material of claim 24, wherein the content of Al of the metal oxide ~~surface treatment~~ layer ranges from 0.001 to 2 percent by weight based on the weight of the positive active material.

26. (currently amended) A positive active material for a rechargeable lithium comprising:

a core comprising a lithium-manganese or lithium-cobalt chalcogenide compound; and

at least two different metal oxide ~~surface treatment~~ layers sequentially formed on the core, wherein one of the metal oxide ~~two the surface treatment~~ layers comprises B.

27. (currently amended) The positive active material of claim 26, wherein the content of B of the metal oxide ~~surface treatment~~ layer ranges from 2×10^{-5} to 2 wt% based on the weight of the positive active material.

28. (currently amended) The positive active material of claim 27, wherein the content of B of the metal oxide ~~surface treatment~~ layer ranges from 0.001 to 2 wt% based on the weight of the positive active material.